

# Instability indices derived from current and future infrared hyperspectral instruments and NWP models: advantages and limitations

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Toulouse

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- I. Case study 20.06.2013 12Z**
    - a. Description**
    - b. Differences in forecast & analysis**
  
  - II. Can we improve with satellite hyperspectral data (MTG-IRS)?**
    - a. Test on a synthetic example**
    - b. Error propagation**
    - c. Current NWCSAF example**

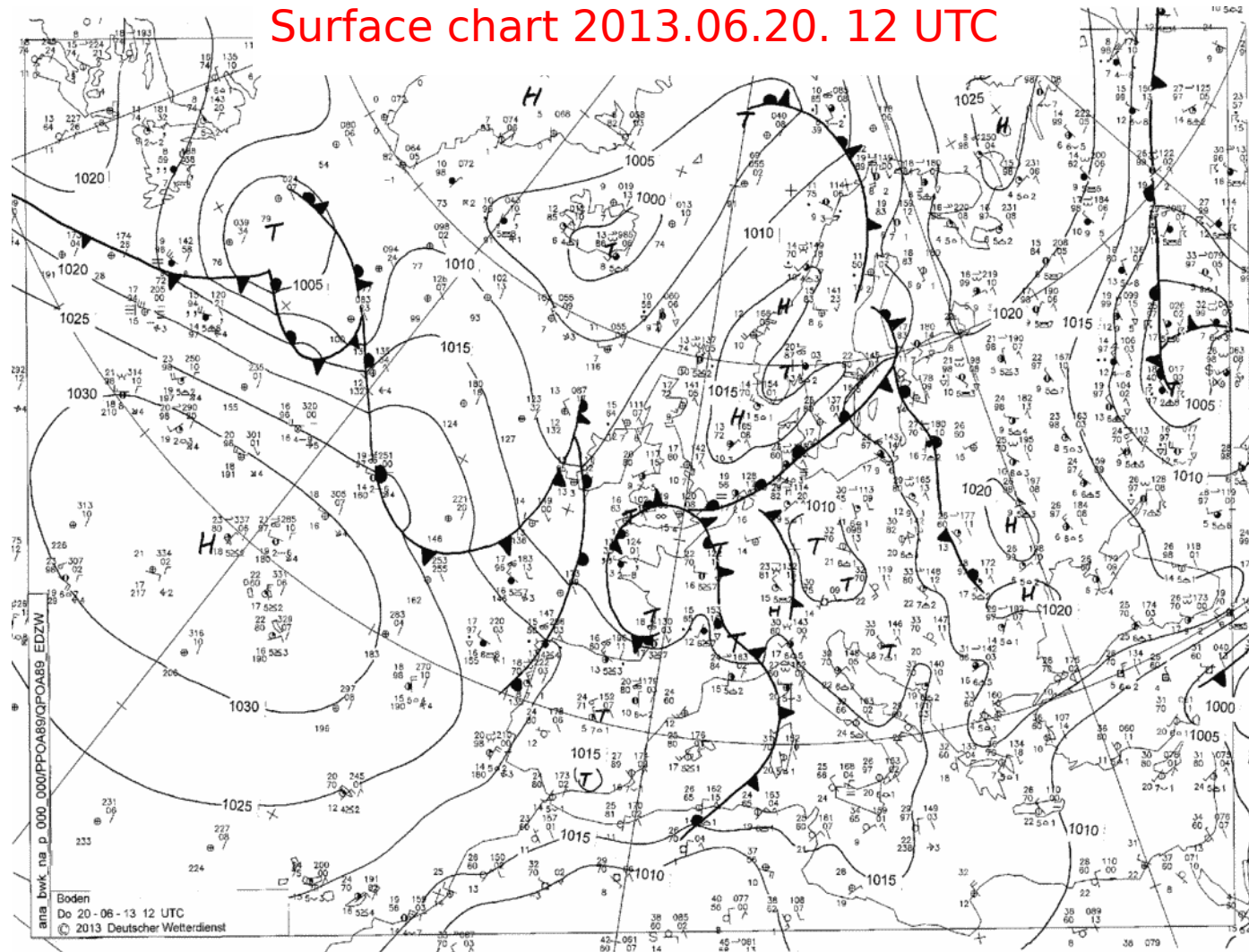
- 
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# Case Study 20.06.2013 12Z Convection over Gemany



## Surface chart 2013.06.20. 12 UTC

A trough approaching from the north-eastern Atlantic merges with a west European cut-off low. Warm and moisture rich boundary layer allows for high instability in this region.



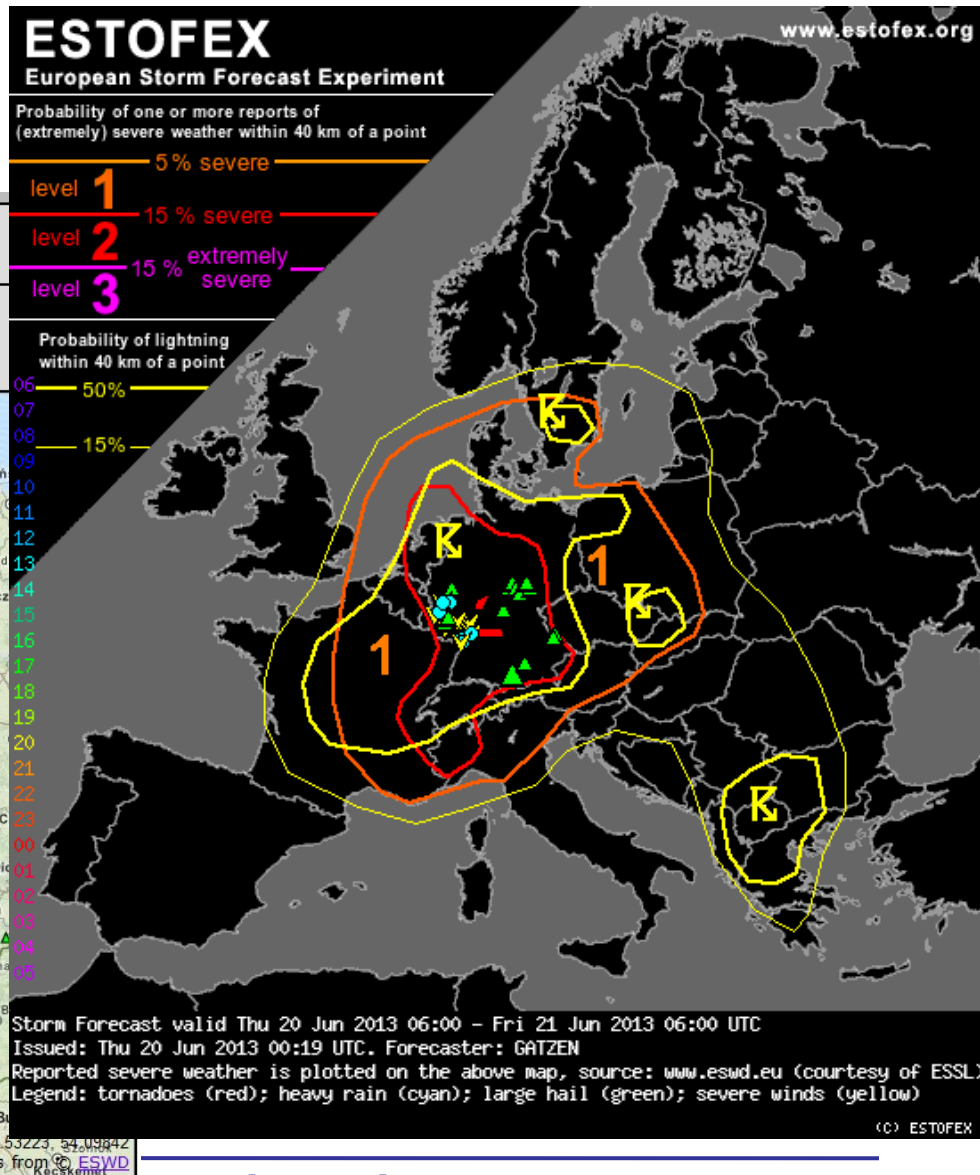
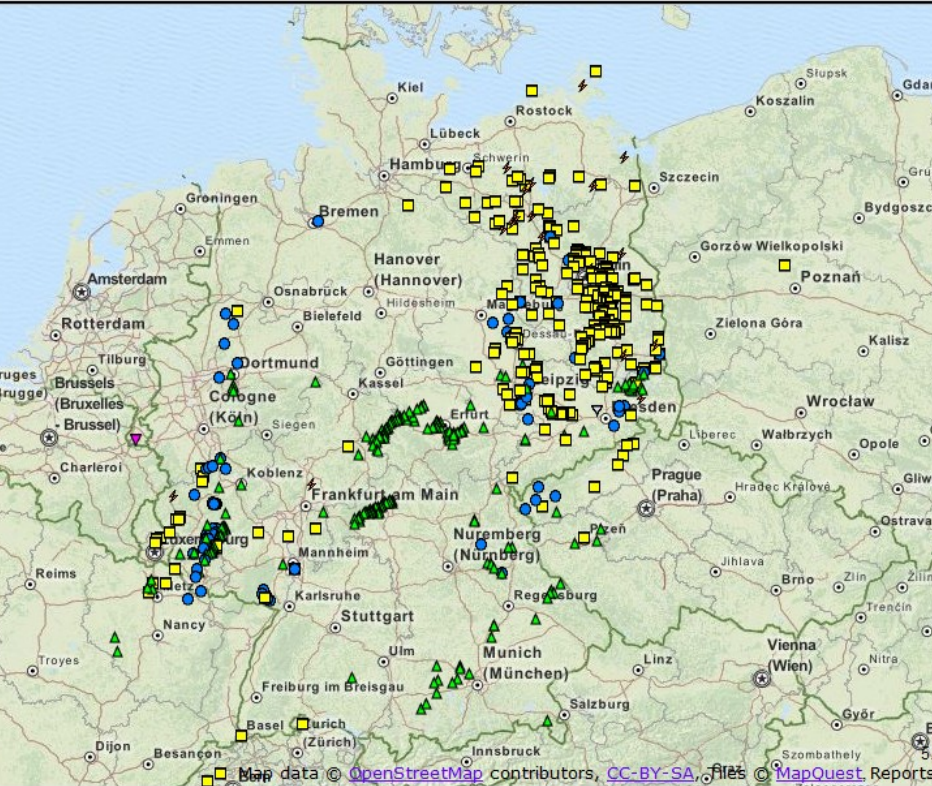
# Case Study 20.06.2013 12Z Convection over Gemany



Actual weather was **much more severe** than expected (COSMO-DE & COSMO-EU model) !

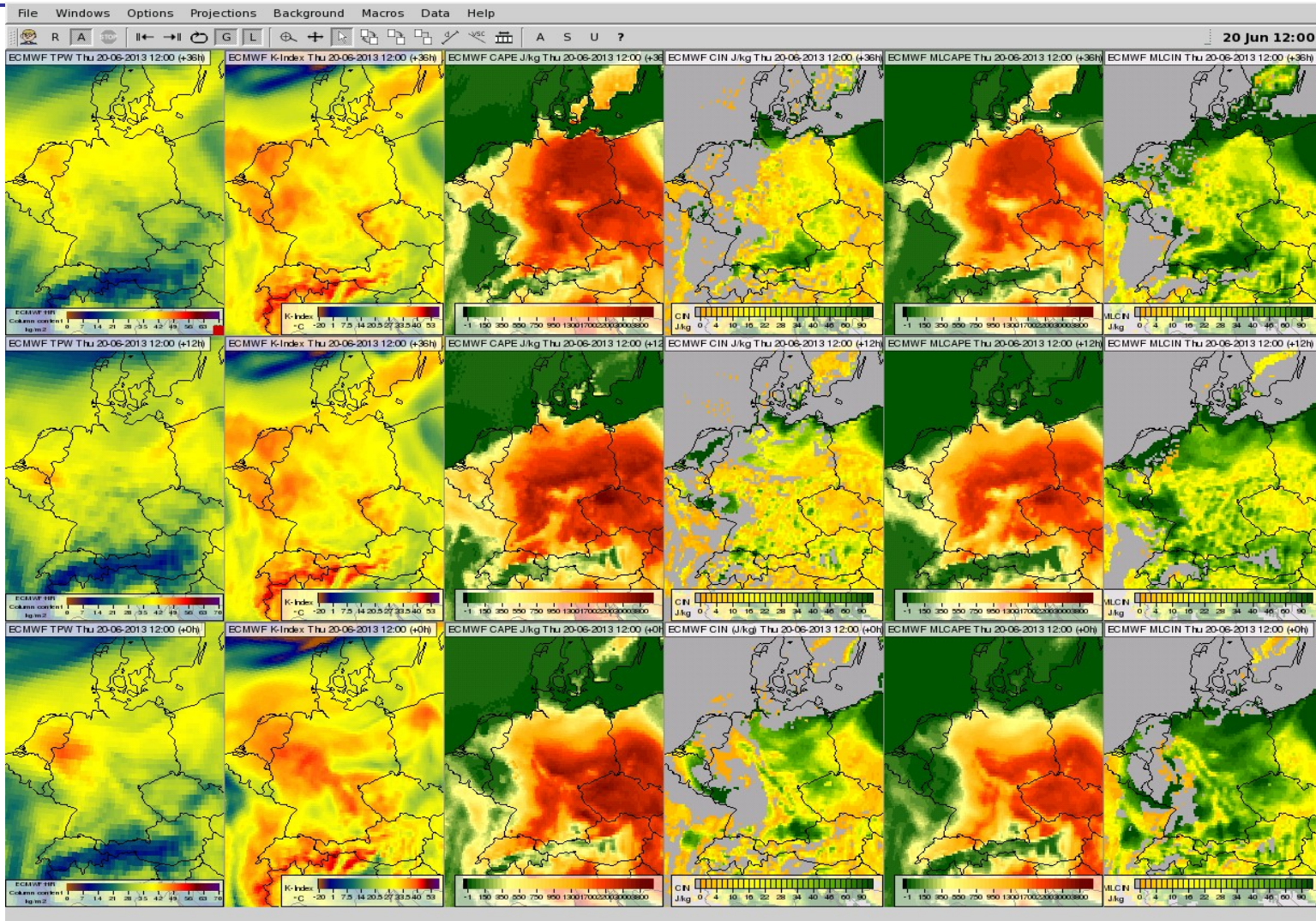
all reports  
g between 20-06-2013 00:00:00 and 20-06-2013 24:00:00 GMT/UTC

f selected reports: 590  
irst 25 selected events are shown in the table  
map [Static Map](#)



# Case Study 20.06.2013 12Z

## What ECMWF showed



19.06.2013  
00Z+36

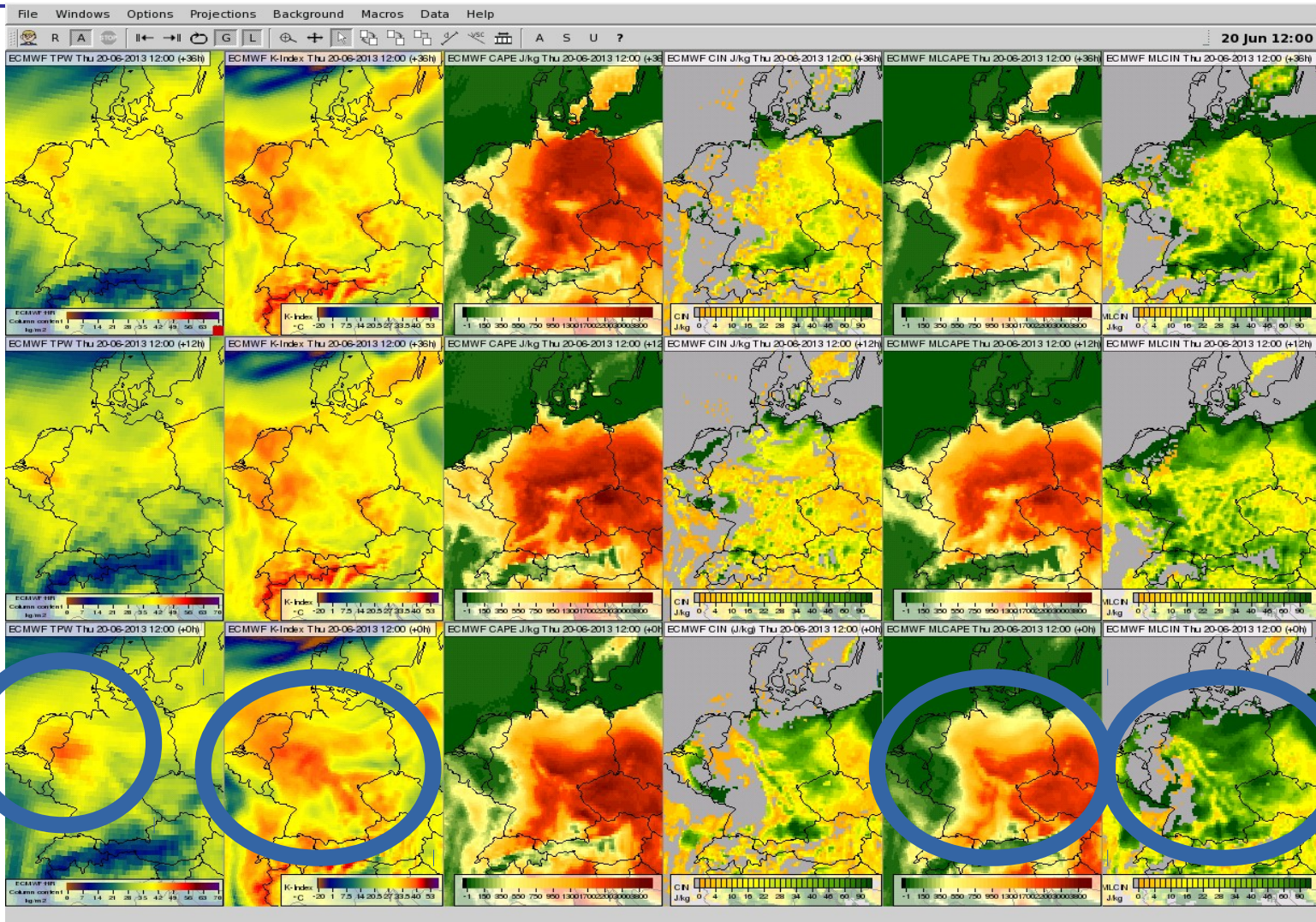
20.06.2013  
00Z+12

20.06.2013  
12Z+00

TPW      K-INDEX      SBCAPE      SBCIN      MLCAPE      MLCIN

# Case Study 20.06.2013 12Z

## Significant differences in TPW & indices!



19.06.2013  
00Z+36

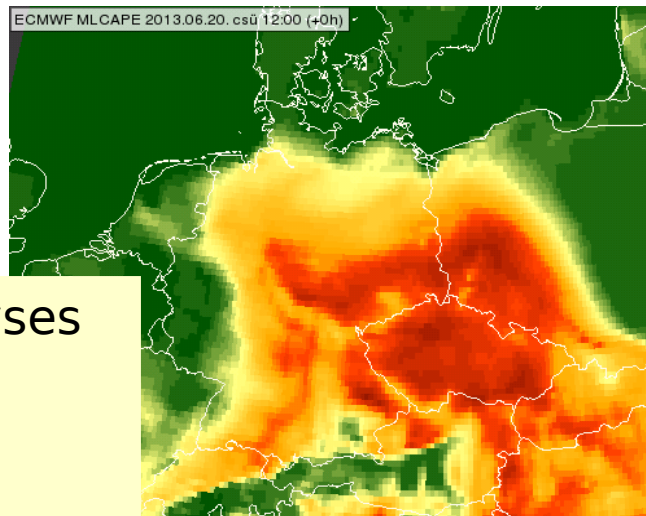
20.06.2013  
00Z+12

20.06.2013  
12Z+00

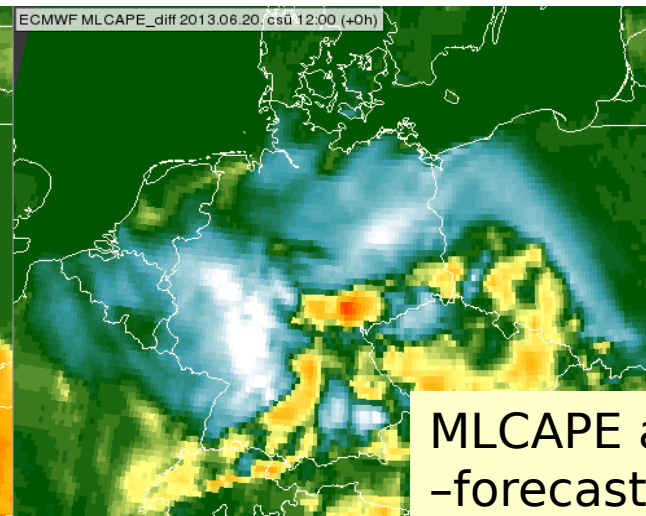
TPW      K-INDEX      SBCAPE      SBCIN      MLCAPE      MLCIN

# Case Study 20.06.2013 12Z

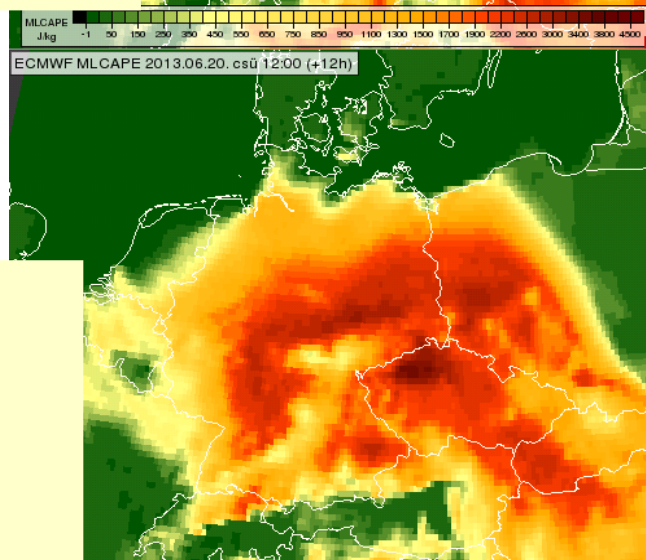
## Significant differences in MLCAPE !



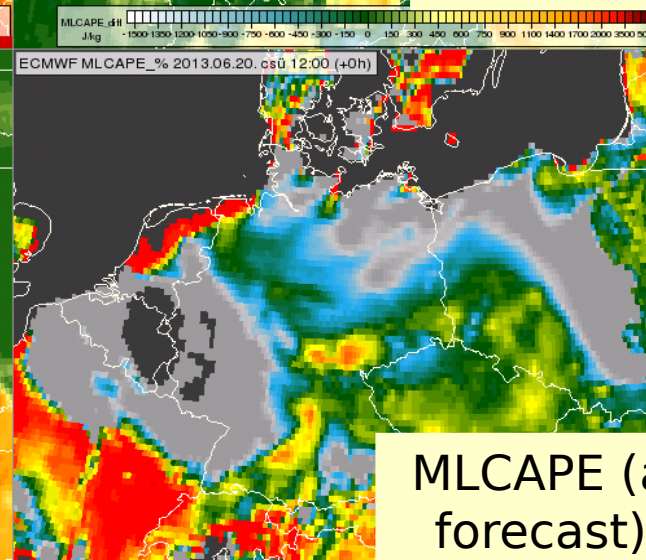
ECMWF analyses  
MLCAPE  
2013.06.20  
12+00 UTC



MLCAPE analyses  
-forecast



ECMWF  
forecast  
MLCAPE  
2013.06.20  
00+12 UTC



MLCAPE (analyses -  
forecast)/analyses

- II. Can we improve forecasts with satellite hyperspectral data (MTG-IRS)?**
  - a. Test on a synthetic example**
  - b. Error propagation**
  - c. Current NWCSAF example**

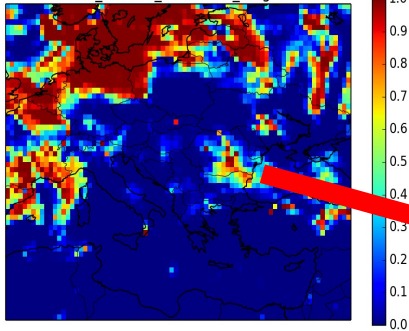
# Case Study 20.06.2013 12Z

## Synthetic example



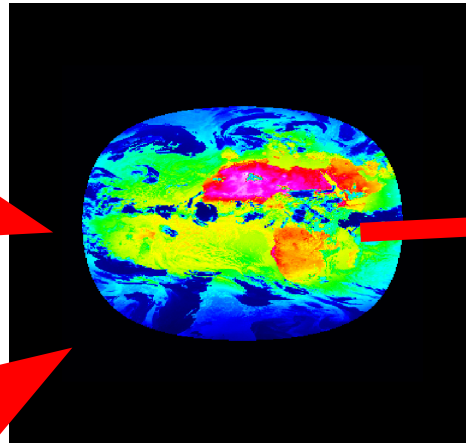
### Total Cloud Cover

TCC\_ECMWF\_20130620\_00.grib



RTTOV 11.2  
With clouds

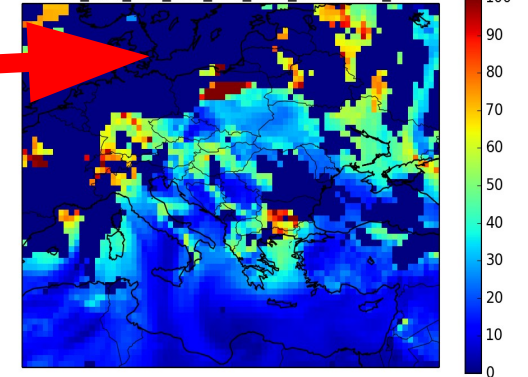
### Simulated MTG-IRS data



Non-Linear  
Regression  
Retrievals  
(NLR)

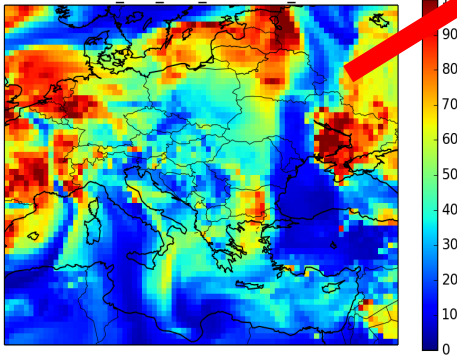
### Retrieval Fields

RH700\_ASV\_NLL\_CAL\_RTT\_ECM\_20130620\_12.nc



NWP Analysis  
20.06.2013 12Z =  
Truth

RH700\_ASV\_ECM\_20130620\_12.nc



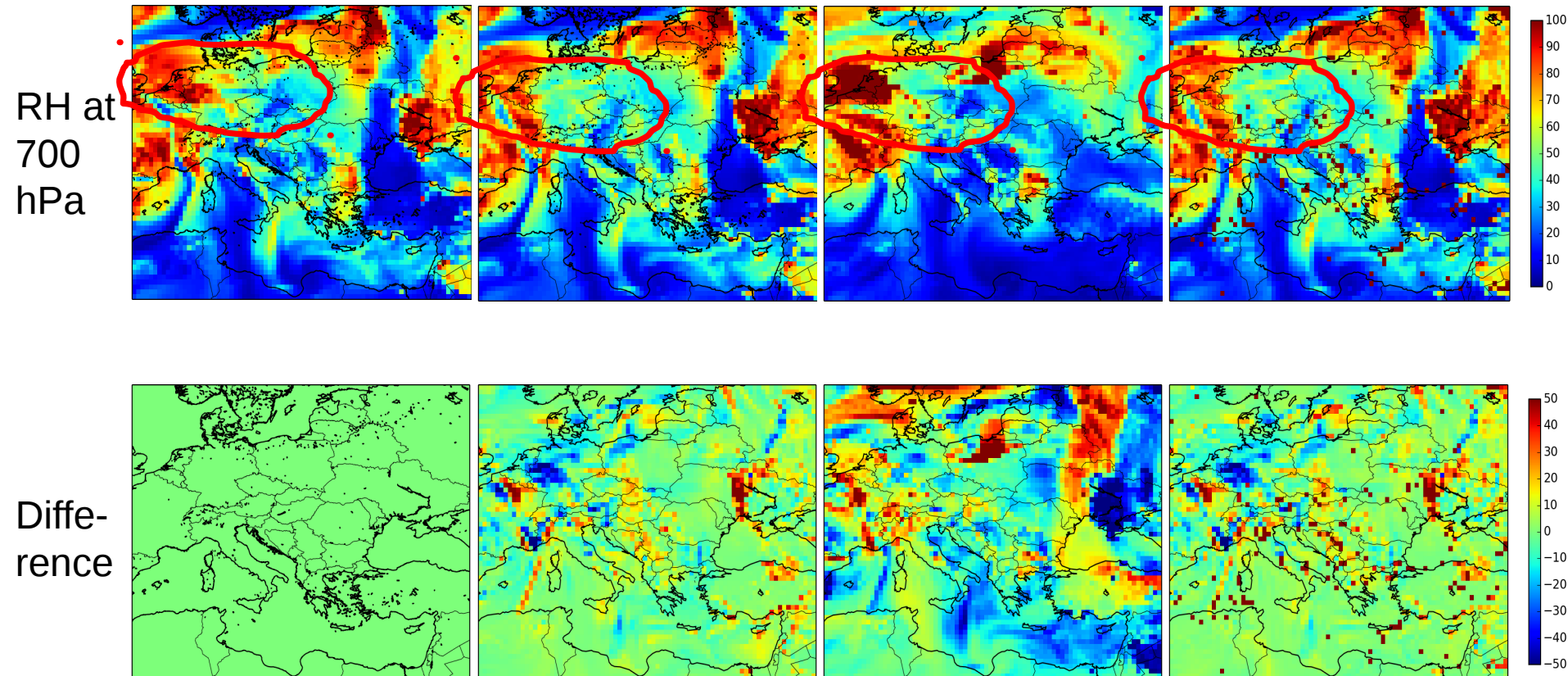
1. **ECMWF Analysis** at 20.06.2013 12Z including cloud properties taken as “**Truth**”. Low 1°x 1° Geographical resolution
2. Simulate all sky IASI radiances with **RTTOV 11.2**
3. Convert to **MTG-IRS spectral** resolution
4. Add spec **MTG-IRS noise**
5. Perform Non-Linear Regression (**NLR**) retrievals retrieval on MTG-IRS radiances (all based on **individual pixel retrievals!**):
  - a. All Sky Non-Linear Regression with climatology as input (**All Sky NLR Clim**)
  - b. All Sky Non-Linear Regression with ECMWF Forecast as input (**All Sky NLR FCT**). Preliminary results!!

Analysis

Forecast

All Sky  
NLR Clim

All Sky  
NLR FCT



# Case Study 20.06.2013 12Z

## Synthetic example: Results for ML CAPE



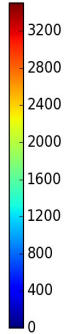
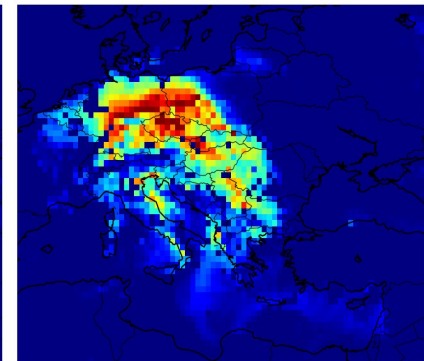
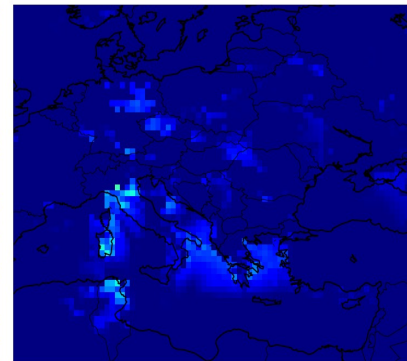
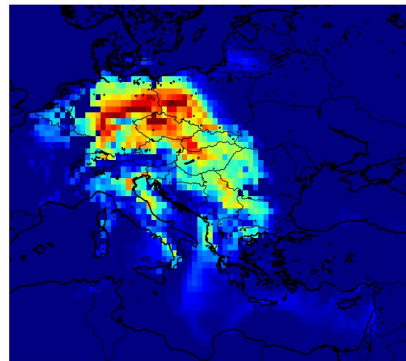
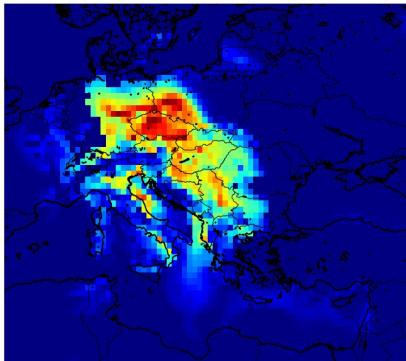
Analysis

Forecast

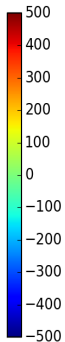
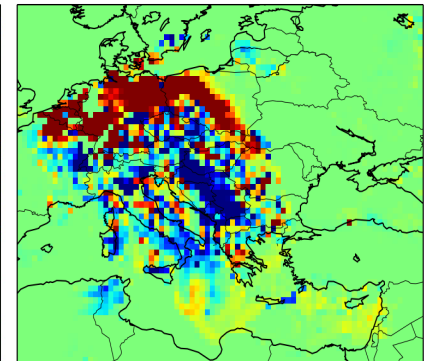
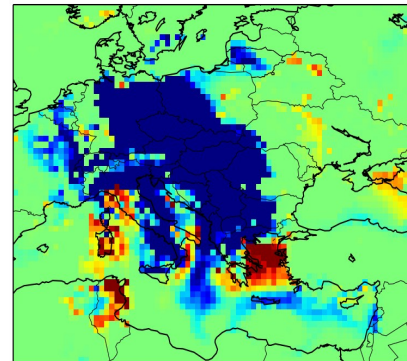
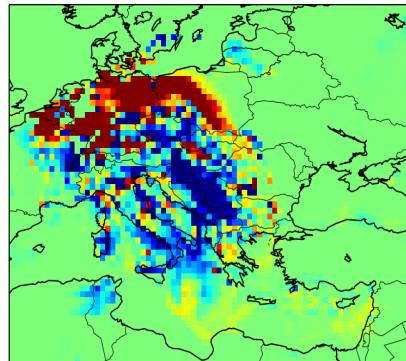
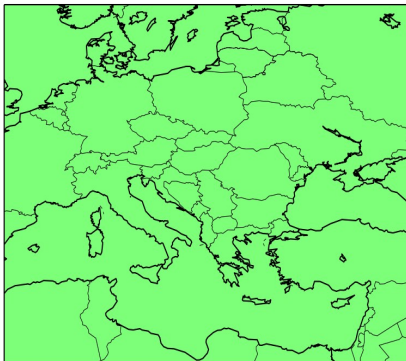
All Sky  
NLR Clim

All Sky  
NLR FCT

ML  
CAPE



Difference



# Case Study 20.06.2013 12Z

## Synthetic example: Results for ML CIN



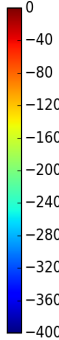
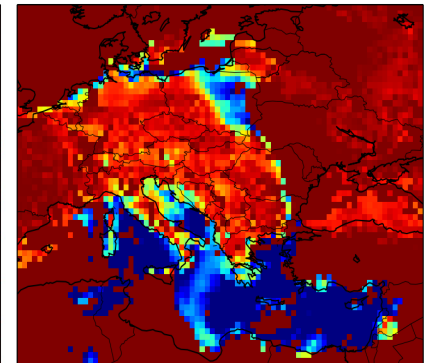
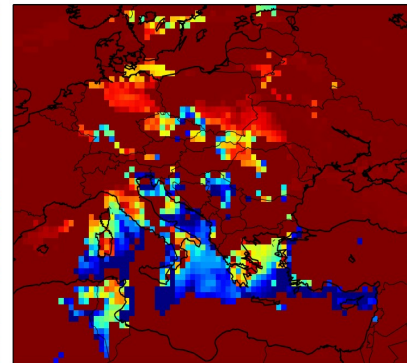
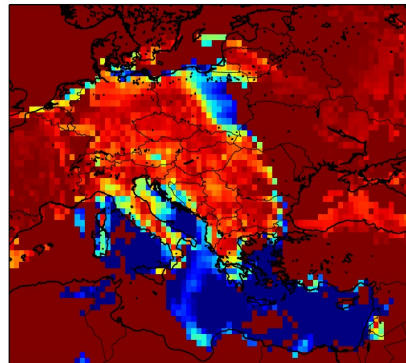
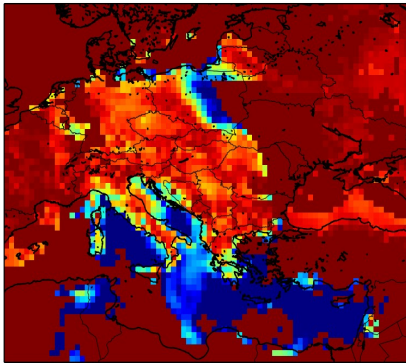
Analysis

Forecast

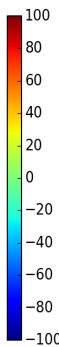
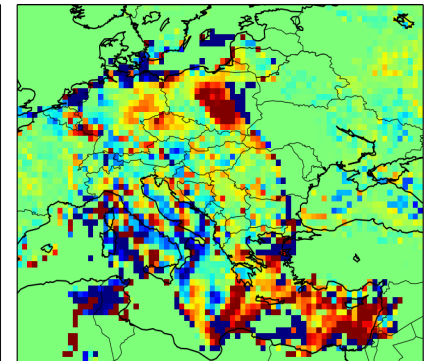
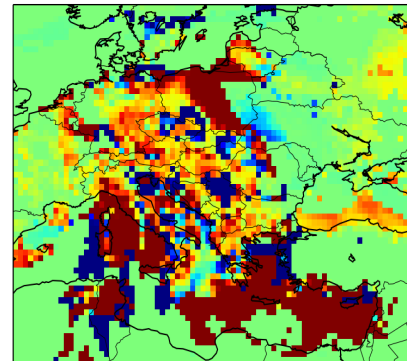
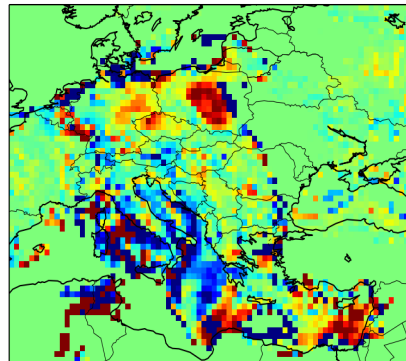
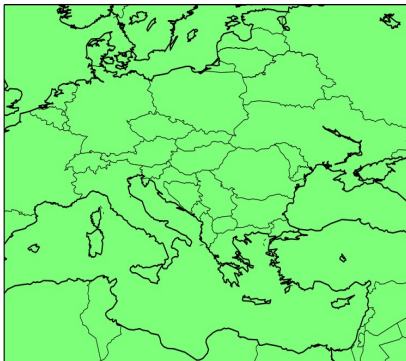
All Sky  
NLR Clim

All Sky  
NLR FCT

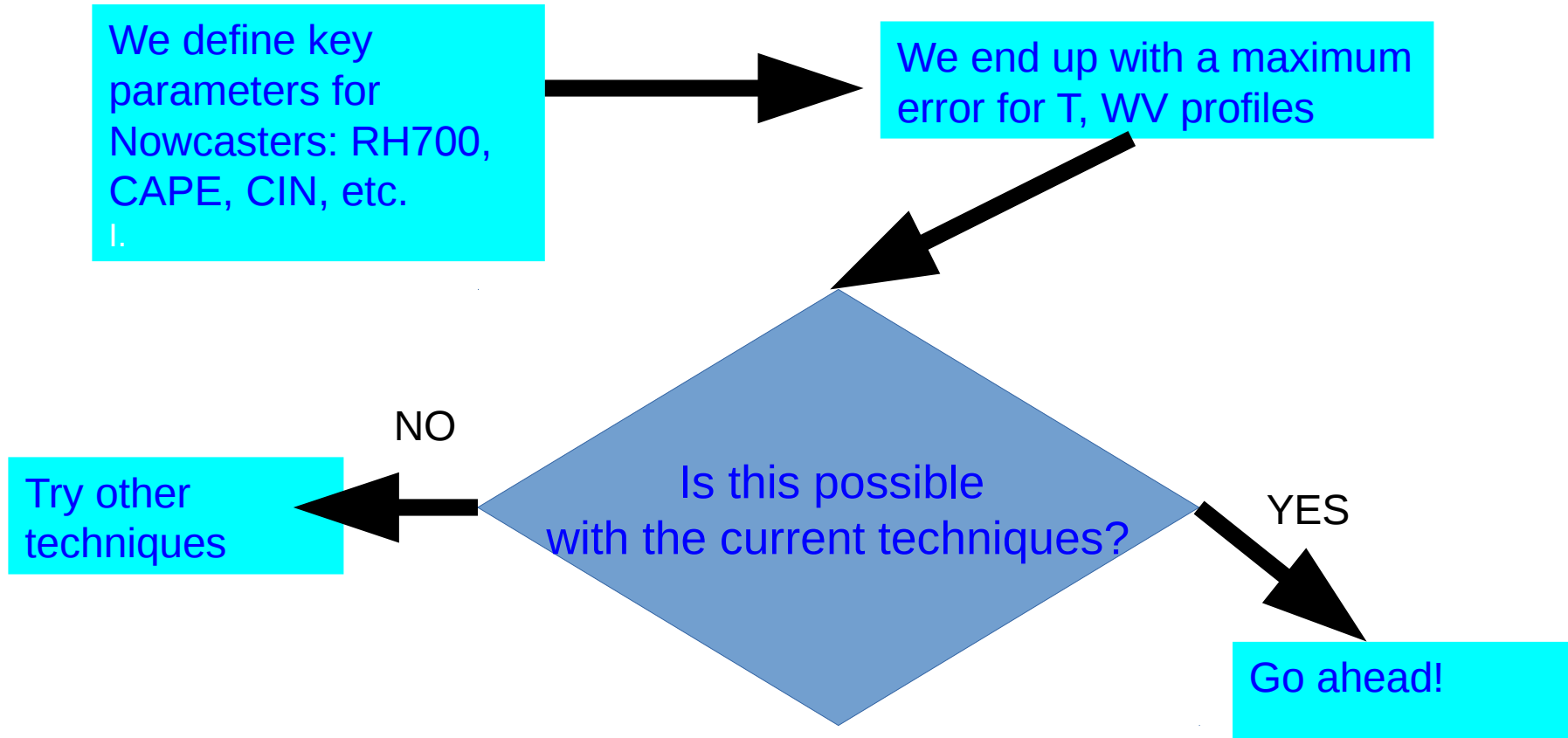
ML  
CIN



Diffe-  
rence



Ideally we would want to start from Error Propagation:



# Case Study 20.06.2013 12Z

## Current NWCSAF Example

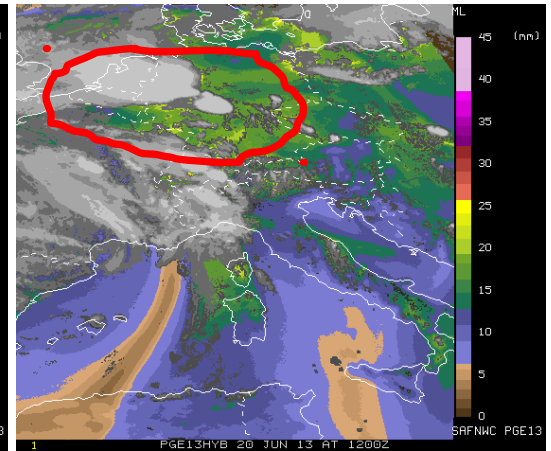
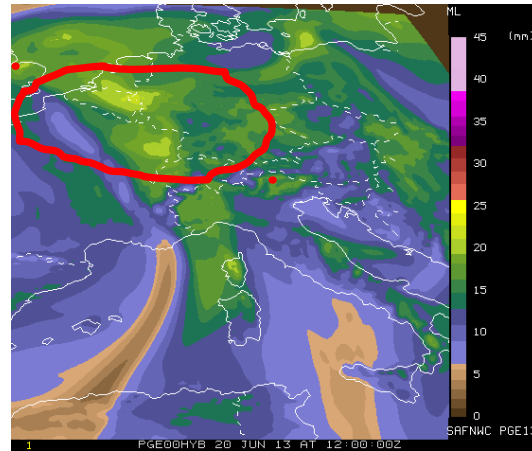
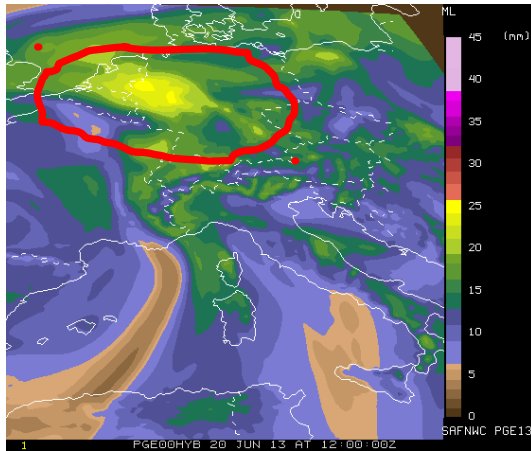


Analysis

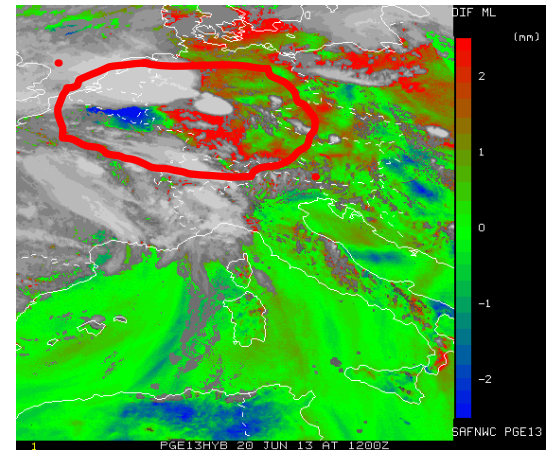
Forecast

NWCSAF  
MSG PG13

Mid  
Layer  
Humi-  
dity



Difference  
with  
Forecast !



1. Calculation of instability indices are very sensitive to errors in the fields
2. Determine maximum allowed errors in the MTG-IRS retrieval fields to keep error of key indices within bounds  
Individual pixel retrieval probably OK for Mid Level Humidity
3. For other fields (CAPE, CIN) a more sophisticated retrieval is likely needed.